



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/724,848	12/01/2003	Alan Charles Cooper	06489 USA	2180

23543 7590 03/20/2007
AIR PRODUCTS AND CHEMICALS, INC.
PATENT DEPARTMENT
7201 HAMILTON BOULEVARD
ALLENTOWN, PA 181951501

EXAMINER

MCCRACKEN, DANIEL

ART UNIT	PAPER NUMBER
----------	--------------

1754

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/20/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/724,848	Applicant(s) COOPER ET AL.	
	Examiner Daniel C. McCracken	Art Unit 1754	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 October 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6,9-11,15-24,37-45 and 47-51 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6,9-11,15-24,37-45 and 47-51 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☒ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Citation to the Specification will be in the following format (S. #, ¶) where # denotes the page number and ¶ denotes the paragraph number.

Declaration under 37 C.F.R. 1.131

The declaration filed on 10/30/2006 under 37 CFR 1.131 has been considered but is ineffective to overcome the Sudan reference.

As an initial matter, in the Final Rejection dated 7/10/2007, the Sudan reference was combined with US 6,159,538 to Rodriguez, et al to reject Claims 1-6, 9-11, 15-24, 37-45, and 47-48 (i.e. *all* pending claims) under 35 U.S.C. §103. The instant declaration was signed by Alan C. Cooper only. In a patent application that contains multiple named inventors, this practice is proper only when the inventor to sign the declaration is the sole inventor of the claim(s) under rejection. *See* MPEP 715.04 I. (B). As all pending claims were rejected with the reference that Applicants seek to overcome with the instant declaration, and there are multiple inventors named, the presumption is that all named inventors were the inventors of the rejected claims. Further, the Examiner notes that Exhibit A (the redacted research notebook) submitted by Applicants was signed by one "Jen L. Vint [*sic*]." The Examiner requests a satisfactory showing by way of affidavit under 37 C.F.R. 1.132 that the inventorship of the application is in fact correct so that the Examiner may properly ascertain whether a rejection under 35 U.S.C. 102(f) is appropriate. For these reasons alone, the declaration is defective.

The evidence submitted is insufficient to establish a conception of the invention prior to the effective date of the Sudan reference. While conception is the mental part of the inventive act, it must be capable of proof, such as by demonstrative evidence or by a complete disclosure to another. Conception is more than a vague idea of how to solve a problem. The requisite

Art Unit: 1754

means themselves and their interaction must also be comprehended. See *Mergenthaler v. Scudder*, 1897 C.D. 724, 81 O.G. 1417 (D.C. Cir. 1897). Here, Applicants' Exhibit A is insufficient in showing conception of the claimed invention – specifically the limitations related to size for which, *inter alia*, the Sudan reference was relied upon. See Final Rejection 7/10/2006. In essence, all that Applicants' Exhibit A shows is that Applicants studied the hydrogen storage capabilities of carbon nanotubes. Admittedly by doing so, Applicants stood in a crowded field. See (S. 2, 13 *et seq.*) (discussing the host of studies on the hydrogen storage capabilities of carbon nanotubes).

Finally, *assuming arguendo* that Applicants did indeed conceive the invention before the Sudan reference, the Examiner notes that the redaction of dates from Exhibit A gives rise to an issue as to Applicants' diligence. Applicants state "It is very important to note that no mass spec. is available for this expt. *It may be possible, even likely*, that the recorded pressure rise is due partially to gas evolution of species other than H₂." (Exhibit A, page 3) (emphasis added). It wasn't until a later date (again, the Examiner cannot ascertain due to the redaction of dates) that Applicants realized that the nanotubes indeed stored hydrogen. See (Exhibit A, page 4) ("The sample was then heated under a dynamic vacuum with a mass spectrometer analyzing the gases evolving from the sample (TPD model, [*sic*] In all cases, H₂ was observed to desorb from the sample to temperature [*sic*] of 500-600 K. CO is also observed at these temperatures.")

In sum, the declaration under 37 C.F.R. 1.131 is substantively and procedurally deficient for the reasons noted above. Accordingly, it is insufficient to antedate the claimed invention over the Sudan reference and the rejections of the Final Rejection of 7/10/2006 are maintained. See Claim Rejections – 35 USC §103, *infra*.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-6, 9-11, 15-24, 37-45, and 47-51 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. At issue with this rejection is the diameter limitations found in independent claims 1, 15, 16, 24, 37, 38, and 47-51. All remaining claims, by way of their status is dependent claims, import the defect discussed below.

Generally speaking, there is parallelism between the claim language and the Specification. *Compare e.g.* “Claim 1”) (“wherein greater than 75 percent of the diameters of the single wall carbon nanotubes range from 0.4 to 0.8 nanometers”) *with* (S. 13, 17-24) (describing the nanotube diameters and percentage of nanotubes that have such a diameter). Thus, there is written support for the claimed limitation related to nanotube diameter, however the specification is lacking as to a description that would convey to one of ordinary skill in the art that Applicants in fact had possession of the claimed invention. Applicants’ Examples illustrate this: The passage discussing Comparative Example 5 states “Raman spectroscopy analysis was used to determine the distribution of SWNT diameters (Table 1).” (S. 24, 15-16). A review of Table 1 shows that nanotubes having diameters of 0.7-2.5 nm were utilized. (S. 27) (“Table 1”).¹

¹ Applicants also assert that Example 2 utilized nanotubes having a diameter of 0.7-1.2 nm. *See* (S. 31-34).

Art Unit: 1754

In a separate experiment, Applicants have apparently run a series of computational thermodynamic simulations to calculate hydrogen adsorption performance based on user-inputted parameters. See (S. 22, 31 *et seq.*) (“For the MD simulations of hydrogen adsorption in SWNT arrays, three armchair nanotubes with diameters ranging from 4 Å to 12 Å, three zigzag nanotubes with sizes similar to the armchair nanotubes and one additional chiral nanotube with a diameter of 8.28 Å *were selected.*”) (emphasis added). That Applicants are able input a physical size limitation into a computer which in turn generates a result to Applicants liking is insufficient to convey to one of ordinary skill in the art that Applicants in fact possessed a hydrogen storage material with the claimed thermodynamic properties or a process that utilized nanotubes of the claimed diameter.

Claims 1-6, 9-11, 15-24, 37-45, and 47-51 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Similarly, the issue here deals with the nanotube diameter limitation and thermodynamic limitations that appear in the independent claims.

The analysis for determining whether a claim is supported by the disclosure is cast in terms of whether “undue experimentation” is necessary to practice the invention. See MPEP 2164.01. In examining the claims in light of the supporting disclosure, the Federal Circuit has provided a non-exclusive list of factors to consider in determining whether a disclosure is

Art Unit: 1754

enabling. *See generally In re Wands*, 858 F.2d 731, 737, 8 USPQ2d 1400, 1404 (Fed. Cir. 1988).

These factors include:

- a. The breadth of the claims;
- b. The nature of the invention;
- c. The state of the prior art;
- d. The level of one of ordinary skill;
- e. The level of predictability in the art;
- f. The amount of direction provided by the inventor;
- g. The existence of working examples; and
- h. The quantity of experimentation needed to make or use the invention based on the content of the disclosure

Id. “Whether undue experimentation is needed is not a single, simple factual determination, but rather is a conclusion reached by weighing many factual considerations.” *Id.* The Examiner has considered all factors in light of all claims rejected makes the following findings of fact:

a. The breadth of the claims

The pending claims vary in scope, arguably distinguishing themselves from the prior art by reciting a host of physical or thermodynamic limitations.

b. The nature of the invention

The invention relates to a hydrogen storage material, as defined by its physical (i.e. length, diameter) and thermodynamic properties (i.e. heat of adsorption).

c. The state of the prior art and the level of one of ordinary skill

Applicants provide a fairly comprehensive although non-exhaustive survey of the prior art literature. *See* (S. 2, 13 *et seq.*). One of ordinary skill in the art would presumably be familiar with carbon nanotubes and their production. One of ordinary skill in the art would not necessarily be familiar with sophisticated computational thermodynamic modeling.

d. The level of predictability in the art

The prior art discussed by Applicants in the Specification and submitted on the Information Disclosure Statement indicates that some level of predictability in the prior art exists insofar as the ability to grow carbon nanotubes and store hydrogen in them.

e. The amount of direction provided by the inventor & the existence of working examples

The examples provided by Applicants provide the best source of direction for practicing the invention, and each is examined in turn:

Examples 1-2 and 4-5 describe a process for treating a commercially purchased nanotube sample with known methods described in the literature. *See e.g.* (S. 20, 32 – 21, 5). The samples were then subjected to testing to determine their adsorption capabilities. (S. 21, 9-10). It should be noted that the commercially purchased nanotubes in Examples 1-2 are 0.7-1.2 nm in length. (S. 27 “Table 1”).

Example 3, by contrast, was a “virtual” experiment. Applicants chose their own physical reality in which to conduct the experiment (i.e. equimolar, isochoric, and isothermal). (S. 22, 14-16). Further, Applicants chose the nanotubes for the computer simulations. *See* (S. 22, 31 *et seq.*) It is apparently here where Applicants draw their support for the diameter limitation – i.e. *by choosing* the diameter limitation. Applicants also chose the geometries utilized (i.e. armchair, zigzag, etc.). *Id.* It was these virtual samples that were analyzed for hydrogen adsorption performance. *See* (S. 23, 9-11).

f. The quantity of experimentation needed to make or use the invention based on the content of the disclosure

Here, arguably infinite experimentation is necessary to make and practice the invention as claimed – certainly more experimentation than Applicants themselves have done: First, actual physical testing (i.e. not on a computer) of the nanotubes of the dimensions claimed

would be necessary. Second, testing with actual nanotube samples² versus “a rectangular box imposed with the periodic boundary condition containing the 1x2x10 primitive cells of the SWNT” for “100 picoseconds (ps)” would be required. (S. 22, 21-23). Third, calculation of the thermodynamic properties based on actual physical measurements from actual nanotubes would be necessary to determine whether the invention could actually be used for hydrogen storage.

In essence, purchasing a material and characterizing its properties, by whatever means, does not constitute a patentable invention.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-6, 9-11, 15-24, 37-45, 47-48 rejected under 35 U.S.C. 103(a) as being unpatentable over P. Sudan et al, *Physisorption of hydrogen in single-walled carbon nanotubes*, 41 Carbon 2377 (2003) (“the Sudan reference”) in view of US 6,159,538 to Rodriguez et al.

As to Claims 1-6, 9-11, 15-24, 37-45, 47-48, the rejection and rationale set forth in the Office Action dated 7/10/2006 is expressly incorporated herein by reference.

With respect to newly added Claims 49-51, to the extent these claims repeat limitations of previously presented claims, the discussion of the previous rejections is incorporated by reference.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel C. McCracken whose telephone number is (571) 272-6537. The examiner can normally be reached on Monday through Friday, 9 AM - 6 PM EST.

² See e.g. I.W. Chiang et al., *Purification and Characterization of Single-Wall Carbon Nanotubes*, J. Phys. Chem. B., 2-3 (2000) (Fig 3-4) (noting the “birds nest” structure of the nanotubes).

Art Unit: 1754

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley S. Silverman can be reached on (571) 272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



Daniel C. McCracken

DCM



STUART L. HENDRICKSON
PRIMARY EXAMINER